Preliminary analysis for identification of priority species of small pelagic shared stocks in GSA01 and GSA03 (Alborán Sea)[1]

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Abstract

Small pelagic resources and particularly sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicholus)* represent an important fishery activity for the countries bordering the Alboran Sea. This paper aims at contributing to the identification of priority species of small pelagic shared stocks in GSA01 and GSA03 (northern and southern Alboran Sea GFCM regions) for carrying out joint stock assessments and promoting new management measures that would allow the sustainability of the resources and its exploitation. The WG on small pelagic shared stocks met twice during 2011 progressing in analysing the available data on the stocks and its exploitation and building a common data base. Moreover a comparative analysis on sardine landings data from 2003-2010 in GSA01 and GSA03 was carried out explaining that the exploitation pattern in sub-areas (GSAs 01 and 03) is different but the total length-frequency distribution of sardine exploited by each country appears to be similar. A tentative in applying a LCA analysis of the Moroccan and Spanish data on sardine using different biological parameters and with the VIT software was unsuccessful but orientated for future works of the WG.

Key words: western Mediterranean, CopeMed, Alboran Sea, Morocco, Spain, Algeria, stock assessments, *Sardina pilchardus*, *Engraulis encrasicholus.*

1. Background

The Alboran Sea is the westernmost part of the Mediterranean Sea, bordering Spain, Morocco and Algeria. The fisheries of small pelagic in this area are very relevant for the three countries. More than 200 vessels from Morocco and Spain fish small pelagic in the Alboran Sea, representing a mean annual landing of 30.000 t, more than 3.500 fishermen directly involved and a landing value of around 24 M€.

During CopeMed phase I, the idea of a Pilot project for small pelagic fisheries in the Alboran Sea was developed and adopted by the Coordination Committee (Tunis, May 2005) where it was agreed that, *given the fact that there are no stocks of fishes or other exploitable living marine resources that are clearly limited to water under the sole jurisdiction of any Mediterranean country, it is recommended that the countries collaborate among themselves and with the Regional Fisheries Organisations to harmonizing their national legislation*

[1] This paper should be cited as follows: Kada O., Álvarez F., Giráldez A., Torres P., Najih M.; Fernández I.L., Bernardon M. and Camiñas J.A. 2011. Preliminary analysis for identification of priority species of small pelagic shared stocks in GSA01 and GSA03 (Alborán Sea). Paper presented at the Working Group on Stock Assessment of Small Pelagic Species (SCSA-SAC, GFCM), (Chania, Crete. Greece, 24-29 October 2011). GCP/INT/028/SPA-GCP/INT/006/EC. CopeMed II *Occasional Papers* nº 14: 11 pp.

governing the fishery exploitation, management and research and, in relation to the pilot project for the Alboran Sea. "*Before the production of co-management decisions, it should be clarified if shared stocks are present in this area, therefore the project should focus more on deepening the knowledge on small pelagic resources*".

The General Fisheries Commission for the Mediterranean (GFCM) stressed the importance of making common assessments of shared stocks of priority species. Fisheries experts of some southern Mediterranean countries carried out analysis that showed the need of exchanging information on fisheries data with the neighbouring northern countries. All this in order to improve knowledge on the status of fisheries resources and to propose new management measures that would allow the sustainability of the resources and its exploitation.

The CopeMed II Coordination Committee, during its 3rd meeting (Tunis, May 2010), agreed to establish scientific cooperation among Algeria, Morocco and Spain for fisheries research on shared stocks of common interest, such as the small pelagic in the Alboran Sea, by organizing Subregional Working Groups on demersal and small pelagic species, in order to gather data to perform small pelagic shared stocks joint assessments and to facilitate the preparation of proposals to the SAC-SCSA Working Group on Stock Assessment of Small Pelagic Species.

To answer the needs of the CopeMed countries and the SAC-SCSA requirements, a workshop, involving scientists and fisheries administrations of the three countries, was organized by CopeMed[2] aiming to discuss the current situation of small pelagic fisheries under the EAF frame, including the national fisheries policy, fishing regulations and management tools. The meeting recommended the organization of a working group with the objective of being permanent and helping to improve the relationship between different actors and countries. The CopeMed II Coordination Committee agreed (4th meeting, Spain, May 2011[3]) to create the WG.

Over the last decades there had been much discussion on the application of the ecosystem approach in the exploitation of natural resources and in fisheries management[4]. "An Ecosystem Approach to Fisheries (EAF) strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries[5]"

2. Introduction

In a previous meeting (CopeMed II, 2011) in March 2011, the WG stressed the existence of differences in the exploitation pattern, marketing strategies and applied fisheries management systems among the three countries of the Alboran region, despite the similarity of the fleets. The WG recommended giving priority on gathering and processing data following the same methodology; standardizing sampling protocols and carrying out assessments for resources management in the Alboran Sea; initiating a revision of the biological aspects of the resources

[2] CopeMed II. 2011. Report of the Working Group on small pelagic fisheries management in the Alboran Sea under the Ecosystem Approach to Fisheries. CopeMed II – ArtFiMed Technical Documents Nº 18 (GCP/INT/028/SPA – GCP/INT/006/EC). Málaga, 2011. 181pp.

[3] CopeMed II. 2011. Report of the Fourth Meeting of the CopeMed II Coordination Committee. Madrid, Spain, 28-29 April 2011. CopeMed II – ArtFiMed Technical Documents Nº17 (GCP/INT/028/SPA - GCP/INT/006/EC). Málaga, 2011. 56 pp.

[4] Publications prepared by the FAO can be consulted (www.fao.org).

[5] FAO (2003). The Ecosystem Approach to Fisheries. FAO Technical Guidelines for Responsible Fisheries, 4 (Suppl. 2):112 p.

to have joint information on the small pelagic stocks and improving communication and coordination between regional governments leading to a common approach to fisheries management for the sustainability of small pelagic resources in the Alboran Sea.

Thus, the First meeting of the permanent CopeMed II Working Group on small pelagic fisheries in the Alboran Sea was celebrated at the CopeMed offices in the Subdelegación del Gobierno de Málaga (Spain) on September 21st-22nd. It was attended by experts from Morocco (Ministry of Agriculture and Maritime Fisheries and the INRH Nador Regional Centre), Spain (Málaga and Palma de Mallorca Centres of the IEO) and Tunisia (Sfax Centre of the INSTM). The objective of this meeting was the revision of current available information on small pelagic shared resources including the exploitation, distribution and migratory patterns of the main species. A revision of all information available corresponding to GSA01 and GSA03 was performed.

3. Methodological information and results

In the absence of representatives from Algeria, national experts from Morocco and Spain presented information on sardine (*Sardina pilchardus*) from GSA01 and GSA03 as a priority species for progressing in the definition of shared stocks according the SAC criteria. Statistical data are currently provided by the national fisheries administrations and used by the national research centres for stocks assessment and fisheries research. The information for the WG was prepared following the SCSA-SAC procedures and data forms.

3.1. Fleets, landing, sampling procedures and acoustic surveys

3.1.1 Morocco

A single sardine stock is identified at GSA03 by national experts. The distribution area extends from M'diq to Saidia. The main concentrations are observed on both sides of Cape Three Forks and near Cape Sidi Abed, in the region of Al Hoceima (Fig. 1). Data included in the reference sheet indicate that not all landings were recorded in GSA03, as there is a small artisanal purse seiners fleet whose catches are not recorded.

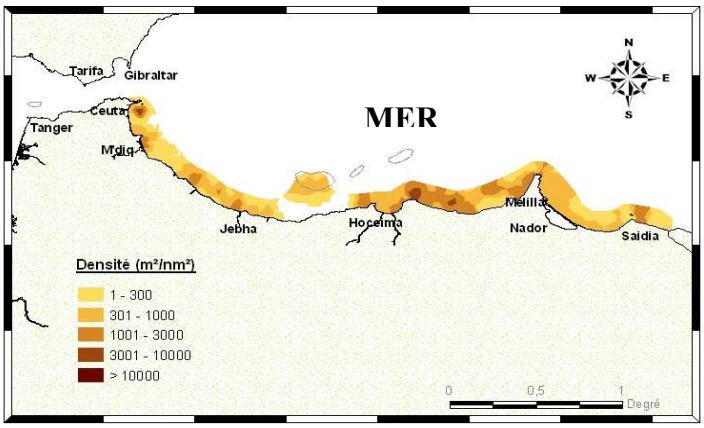

Fig. 1. Map of spatial distribution of sardine abundance indices in GSA03 (Moroccan Alboran Sea).

The fleet has a high annual variability in the number of active vessels (Table 1) resulting not in an increase or decrease but in changes in fleets fishing grounds (Mediterranean or Atlantic) which can be understood as an authorized fleets migration to optimize the fishing strategy for commercial purposes.

		Nº Vessels									
Gear	**Fleet Segment**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Purse Seine	*6 - 12 meters*				18	11	14	15	9	10	8
Purse Seine	*12 - 24 meters*				120	79	95	115	120	118	110
Purse Seine	*> 24 meters*				1	2	4	4	6	8	6

Table 1. General description and evolution of the fleet in GSA03.

Landings length-frequency distribution is recorded at the eastern region of northern Morocco in the ports of Al-Hoceima (3 days / week), Nador (2 days / week) and Ras Kebdana (1 day / week). In the port of M'diq (western region) samplings are conducted less frequently and irregularly. Exploited sardine is characterized by sizes from 8 to 20 cm. Main specimens sizes pattern are around 18 cm but a secondary pattern of 15 cm specimens is also found.

For over a decade, Moroccan sardine yield in GSA03, varies between 20.000 and 8.000 tonnes/year. The average yield during the period 2004-2008 was 13.000 tonnes/year (Fig. 2).

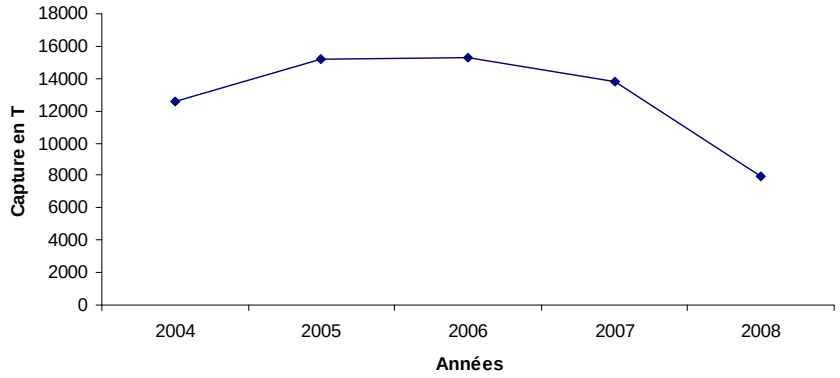

Fig. 2. Evolution of the sardine landings in GSA03.

Length-Frequency Distribution, biological samplings and parameters were recorded by the INRH only in 2001 and 2002. The growth parameters used by the INRH (L∞, K and to) are given in Table 2.

Species	a	b	L∞ (cm)	K (cm/year)	to (year)	Reference
Sardine	0,0066	3,0582	21,3	0,56	-0,67	INRH-Nador

Table 2. Sardine from Morocco: biological parameters (a,b: length-weight relationship parameters. L∞: asymptotic length. K: instant growth tax. t0: age corresponding L=0).

Assuming the SAC procedures, it was recommended that the national research institutions should provide at least once a year with biological parameter sampling data for the proper monitoring.

The annual ACOUMED acoustic evaluation campaigns were conducted by the INRH in the period 2005-2008. Since 2008 they were suspended due to other priorities of Morocco. The campaign covered the area between Ceuta and Saidia at depths from 15 to 400 m.

The expected objectives of acoustic campaigns are: mapping the spatial distribution of the main small pelagic species; determination of their abundance indices and estimation of the stocks

biomass. Data on the spatial distribution of small pelagic species and their abundance indices also permit the determination of the main areas of concentration of these resources and the development of fisheries maps for the benefit of the pelagic fishery (Fig. 1).

3.1.2. Spain

Sardine and anchovy (*Engraulis encrasicholus*) are the two target species for the Spanish fleet. Data on landings confirmed that sardine distribution pattern in eastern area of GSA01 is different to that in the western area. Landings in GSA01 eastern area represented about 5% of the total, so any samplings were carried out in this zone. Ceuta (a Spanish city in the north of Africa) purse seine fleet was included in the records of the GSA01 and its sardine landings represented about 30 t in 2003. Sardine catches are highly variable (Fig. 3), while anchovy shows very low levels with immediate increase when there is a good recruitment as in 2001.

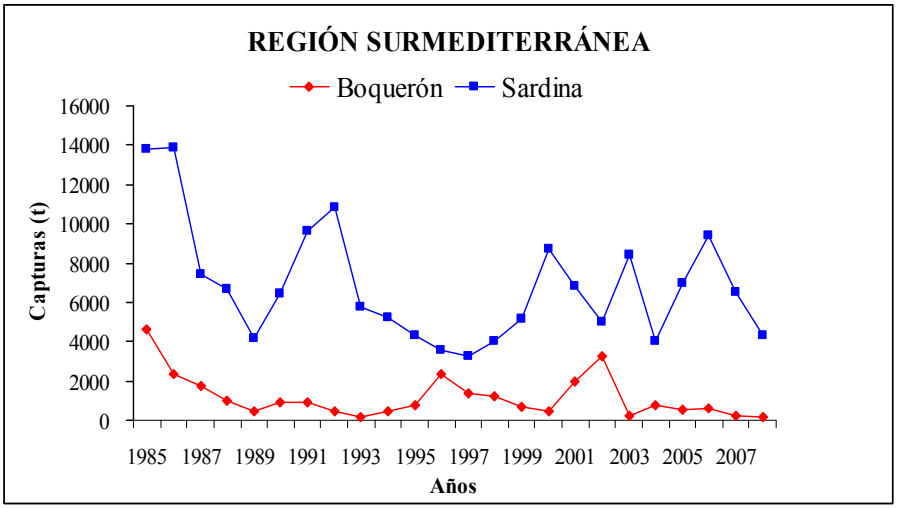

Fig. 3. Sardine and anchovy landings (1995-2008) of the Spanish fisheries.

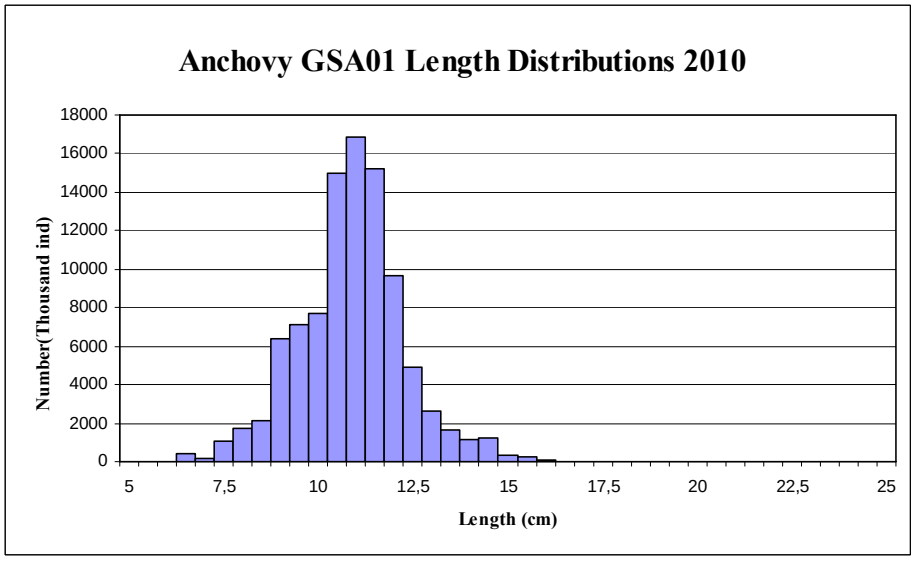

Fig. 4. Anchovy length frequency distribution by size in 2010. GSA01 Spanish fisheries.

IEO is responsible for recording biological data, including landings length-frequency distribution (4/5 samplings/month from purse seiners) in the ports of Estepona, Fuengirola, Málaga, Adra and Almería. Biological sampling (twice a month) and biological parameters

(twice a month) are recorded in Estepona, Fuengirola and Málaga. The number of sardine specimens sampled was 5 by 0'5 cm interval and 10 otoliths by 0.5 cm interval per quarter.

		Nº Vessels										
Gear	***Fleet Segment***	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Purse Seine	*6 - 12 meters*							32	30	28	20	16
Purse Seine	*12 - 24 meters*							103	106	103	93	88
Purse Seine	*> 24 meters*							0	0	0	0	0
Purse Seine	*TOTAL*	187	184	168	167	160	149	135	136	131	113	104

Table 3. General description and evolution of the fleet in GSA01.

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Landings	9325	7457	5348	8244	3964	7208	10002	6766	4423	5926	7173
CPUE	1369	1255	1010	1292	851	1302	1505	1252	1070	1279	1213

Table 4. Landings (t) and CPUE (Kg/day) by purse seiner fleet in GSA01.

Spanish acoustic surveys (series ECOMED from 1991 until 2009 when started the series MEDIAS) are carried out by the IEO in the Mediterranean, from the frontier of France to the Alboran Sea. Unfortunately, no acoustic surveys were carried out since 2005 in GSA01 due to time restrictions of the research vessel. In the last decade complete acoustic surveys were carried out only in 2004 and 2005 (Fig. 5).

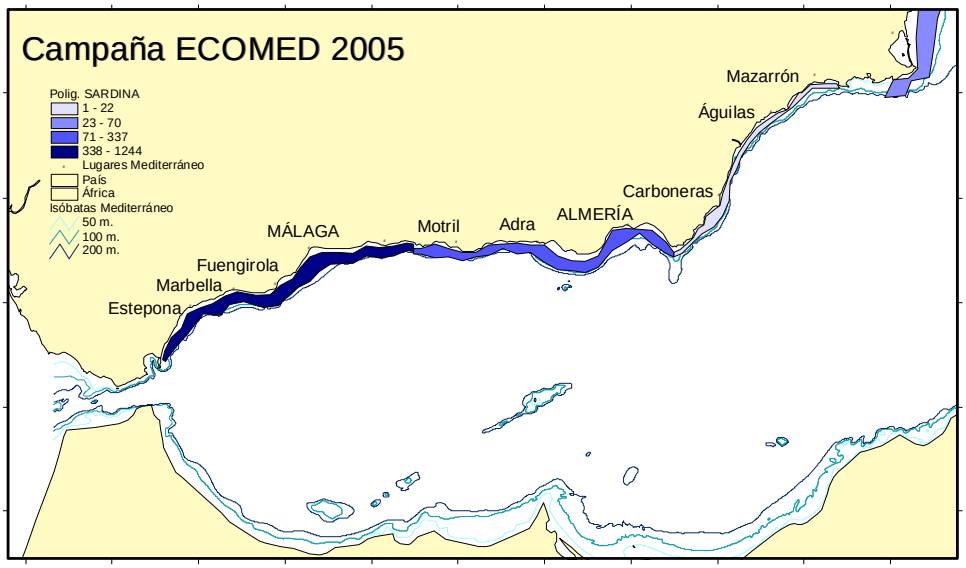

Fig. 5. Spatial distribution of acoustic energy attributed to sardine in the Alboran Sea and Gulf of Vera (GSA01) from ECOMED 2005 campaign.

3.2 Morocco and Spain's sardine length-frequency distribution joint analysis

A first attempt of analysis with the data from Morocco and Spain, considering the series of landings and biological samplings was carried out. First of all, a joint comparative analysis of the length-frequency distribution of sardine landings in Morocco and Spain in order to achieve a first approximation to the pattern of exploitation of both fleets was decided. Secondly, the elaboration of a common database between the two countries in order to perform a joint preliminary assessment based on Length Cohort Analysis (LCA). The two analyses were carried out with data from the period 2003-2010. Figure 6 show the graphic of the results.

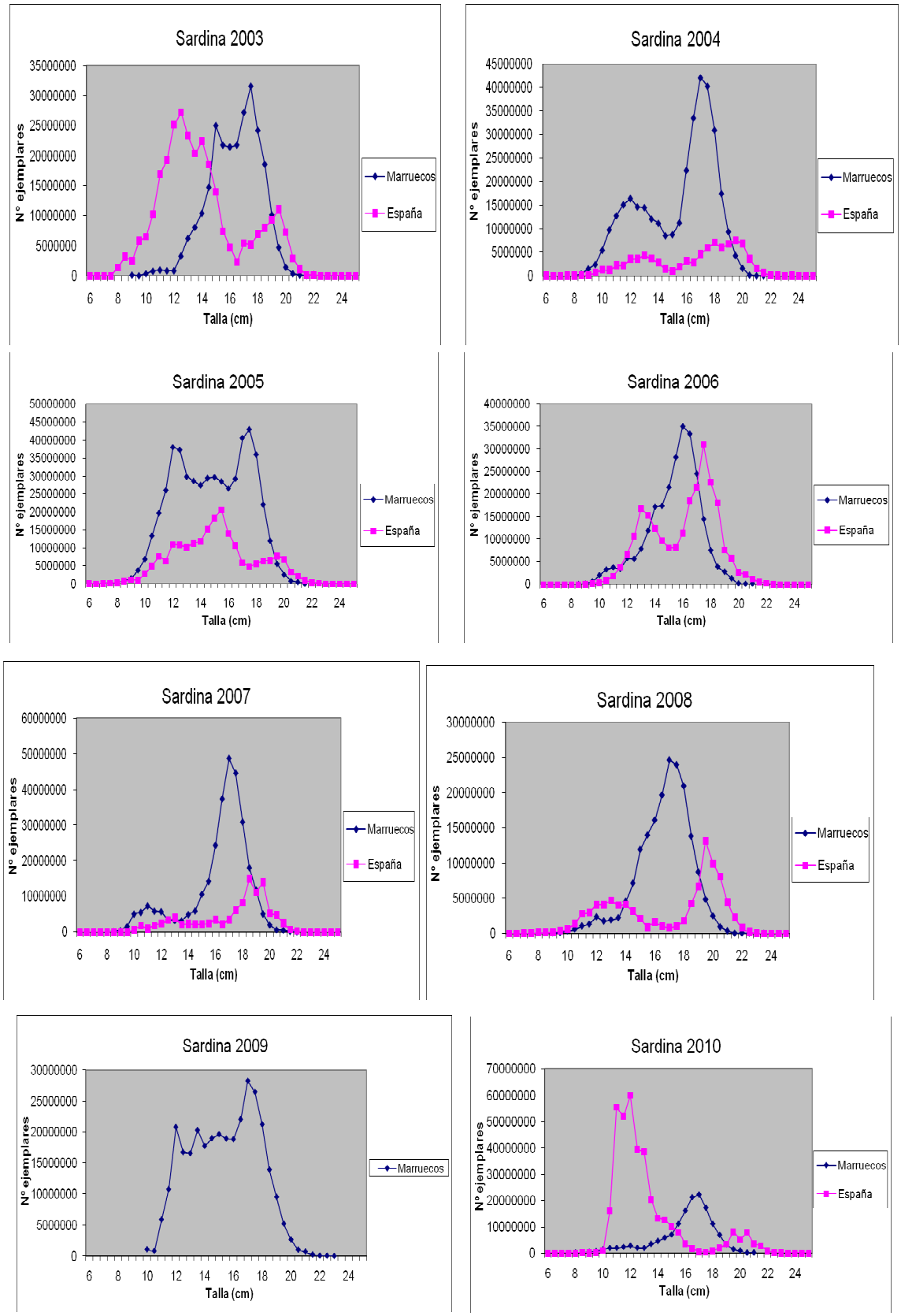

Fig. 6. Sardine landing size distributions in Morocco and Spain (2003-2010).

The comparative analysis of the landing size distributions showed that both countries catch a large range of sizes with different annual modes. In GSA03, Moroccan fleet exploit regularly a range of sizes between 13 and 22 cm while in GSA01 two major ranges of sizes are exploited by the Spanish fleets, including juveniles/annual recruitment (in high demand for local consumption) and adults. These large ranges of sizes of sardine landed in GSA01 from 2008 represent a new fishing strategy of the fleet as a consequence of the high demand of sardine for feeding -fattening- bluefin tuna kept in captivity in Spain before commercialization. From 2006-07 the larger sizes in Spain are substantially higher than the maximum sizes in Morocco.

From this preliminary analysis it is inferred that the pattern of exploitation in both sub-areas (GSAs 01 and 03) is different but the total length-frequency distribution of sardine exploited in both GSAs appears to be similar. It was concluded and recommended the length-frequency distribution analysis of the catches from Morocco and Spain by month for the total period (2003-2010) that could provide better and accurate information on the exploitation pattern of both fleets in order to analyze possible similarities.

3.3 Joint stock assessment of GSA01 and GSA03 sardine

A joint stock assessment of sardine, based on the length-frequency distribution of landings data in both sub-areas for the period 2003-2008, applying the software VIT (Lleonart and Salat, 1992[6]) was undertaken. The joint analysis was arisen considering three scenarios:

- Using joint data and Spanish biological parameters.
- Using joint data and Moroccan biological parameters.
- Using joint data and the biological parameters that best fit to the fishery.

Parameter	Morocco	Spain	Comments
L inf	21.3	22,00	
K	0,56	0,45486	
to	-0,67	-1.41571	
M	0,2	Age vector	[1]Average in Spain is 0,45
a	0,0066	0,0059	
b	3.0582	3,1406	
Size at fist maturity	13,3	13,5	
Year obtained	2002	2009	Spanish parameters correspond to the last assessment in 2010

Table 5. Parameters used in the length-frequency distribution joint assessment.

The tentative in applying a LCA analysis of the Moroccan and Spanish data on sardine using different biological parameters and with the VIT software was unsuccessful but orientated for future works. It was agreed to continue with the analysis by correspondence and to present the results, if any, to the SCSA Small Pelagic Species WG in Chania.

4. Conclusions and recommendations

The main short term objective of the WG was to obtain scientific information on small pelagic fisheries to confirm if sardine, the common exploited species with commercial

[6] Lleonart J. and J Salat. 1992. VIT Fisheries Analysis Program. *Inf. Téc. Sci. Mar.* 168-169. Barcelona, July 1992. 116 pp.

interest for both Spanish and Moroccan fleets, represents a single stock in the Alboran Sea. In order to achieve this objective the WG recommended:

To continue reinforcing the collaboration and the exchange of information between the INRH and IEO and the two national fisheries administrations for improving the knowledge on sardine and the anchovy exploitation and to reinforce the scientific collaboration within the CopeMed II WG.

The elaboration, for the next meeting, of a document with relevant information on sardine migration in the Alboran Sea in order to improve the knowledge of the movements of the sardine in the region.

To recommend to CopeMed II to consult the two fisheries administrations in Morocco and Spain and the research institution INRH and IEO in order to analyze the vessel possibilities and funds required to carry out a joint acoustic survey in the Alboran Sea to evaluate simultaneously the sardine of the GSA01 and GSA03.

To recommend to CopeMed II to consult the two fisheries administrations in Morocco and Spain and the research institution INRH and IEO to update the joint analysis carried out in the last eighties between IEO and INRH on eggs and larvae abundance and distribution and the influence of the Atlantic current in the distribution of sardine and anchovy by performing a joint campaign between Morocco and Spain in the whole Alboran Sea, preferably in the spawning season of sardine, due to the lack of current surveys. Thus, current abundance, areas of concentration and pathways of larvae and eggs of sardine and anchovy, applying traditional and new methods of research, will be identified.

After revision of the Moroccan and MEDIAS protocols being used by the INRH and the IEO and following the SAC recommendations of having common acoustic methods, it was agreed to recommend the most common protocol for Acoustic Survey (MEDIAS) to be applied in the Alboran region and to prepare proposals for the next meeting of the WG in order to advance in the standardization.

To perform monthly length-frequency distribution analysis of Morocco and Spain catches for the period 2003-2008 in order to obtain accuracy and useful information on the exploitation pattern of both fleets and their similarities.

To recommend the support of CopeMed II in the organization of a scientific network of experts and specialists on small pelagic species of the three countries bordering the Alboran Sea and the creation of a site, within the CopeMed II web page, to put the list of experts and all the information related with the small pelagic in the two GSAs in common.

The WG agreed that the remaining analysis with VIT software between INRH and IEO using different parameters should be completed.

The WG recommended the support of CopeMed II for the organization of a new meeting in 2012 keeping the dates of this year. It was also recommended that the next meeting should take place in Morocco.

References

Carocci, F.; Bianchi, G.; Eastwood, P.; Meaden, G. Geographic information system sto support the eco system approach to fisheries: status, opportunities and challenges. *Fisheries Technical Paper.* No. 532. Rome, FAO. 2009. 101p.

CopeMed II. 2011. Report of the Working Group on small pelagic fisheries management in the Alboran Sea under the Ecosystem Approach to Fisheries. CopeMed II – ArtFiMed Technical Documents Nº 18 (GCP/INT/028/SPA – GCP/INT/006/EC). Málaga, 2011. 173pp.

De Young, C.; Charles, A.; Hjort, A. Human dimensions of the ecosystem approach to fisheries: an overview of context, concepts, tools and methods. *FAO Fisheries Technical Paper.* No. 489. Rome, FAO. 2008. 152p.

FAO. 2010. The ecosystem Approach to Aquaculture. *FAO Technical Guidelines for Responsible Fisheries.* No. 4, Suppl. 2 Rome, FAO. 2003. 112p.

FAO-CABI. 2008. Edited by Gabriella Bianchi and Hein R. Skjoldal.

FAO. Fisheries Department. The ecosystem approach to fisheries. *FAO Technical Guidelines for Responsible Fisheries.* No. 4, Suppl. 2 Rome, FAO. 2003. 112p.

FAO. Fisheries Management. 2. The ecosystem approach to fisheries, 2,1 Best practices in ecosystem modeling for informing an ecosystem approach to fisheries. *FAO. Technical guidelines for Responsible Fisheries.* No.4, Suppl. 2, Add. 1. Rome, FAO. 2008. 78p.

FAO. Fisheries Management. 2. The ecosystem approach to fisheries, 2.2 The human dimensions of the ecosystem approach to fisheries. *FAO. Technical guidelines for Responsible Fisheries.* No.4, Suppl. 2, Add. 2. Rome, FAO. 2009. 88p.

FAO. Putting into practice the ecosystem approach to fisheries. Rome, FAO, 2005. 76p

Plagányi, É.E. Models for an ecosystem approach to fisheries. *FAO. Technical Paper.* No. 477. FAO. 207. 108p.